

# Freemscale Semiconductor

## Technical Data

MRF18085A

Rev. 4, 12/2004

# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

Designed for GSM and GSM EDGE base station applications with frequencies from 1800 to 2000 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN-PCS/cellular radio and WLL applications. Specified for GSM - GSM EDGE 1805-1880 MHz.

- GSM and GSM EDGE Performance, Full Frequency Band (1805-1880 MHz)  
Power Gain - 15 dB (Typ) @ 85 Watts CW  
Efficiency - 52% (Typ) @ 85 Watts CW
- Internally Matched, Controlled Q, for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 5:1 VSWR, @ 26 Vdc, @ P1dB Output Power, @ f = 1805 MHz
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Available with Low Gold Plating Thickness on Leads. L Suffix Indicates 40μ" Nominal.
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

**MRF18085AR3**  
**MRF18085ALSR3**

**1800-1880 MHz, 85 W, 26 V**  
**GSM/GSM EDGE**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**

**CASE 465-06, STYLE 1**  
**NI-780**  
**MRF18085AR3**

**CASE 465A-06, STYLE 1**  
**NI-780S**  
**MRF18085ALSR3**

**Table 1. Maximum Ratings**

| Rating                                                                | Symbol           | Value        | Unit      |
|-----------------------------------------------------------------------|------------------|--------------|-----------|
| Drain-Source Voltage                                                  | V <sub>DSS</sub> | -0.5, +65    | Vdc       |
| Gate-Source Voltage                                                   | V <sub>GS</sub>  | -0.5, +15    | Vdc       |
| Total Device Dissipation @ T <sub>C</sub> = 25°C<br>Derate above 25°C | P <sub>D</sub>   | 273<br>1.56  | W<br>W/°C |
| Storage Temperature Range                                             | T <sub>stg</sub> | - 65 to +150 | °C        |
| Operating Junction Temperature                                        | T <sub>J</sub>   | 200          | °C        |

**Table 2. Thermal Characteristics**

| Characteristic                       | Symbol           | Value <sup>(1)</sup> | Unit |
|--------------------------------------|------------------|----------------------|------|
| Thermal Resistance, Junction to Case | R <sub>θJC</sub> | 0.79                 | °C/W |

**Table 3. ESD Protection Characteristics**

| Test Conditions  | Class        |
|------------------|--------------|
| Human Body Model | 1 (Minimum)  |
| Machine Model    | M3 (Minimum) |

1. Refer to AN1955/D, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rf>.  
Select Documentation/Application Notes - AN1955.

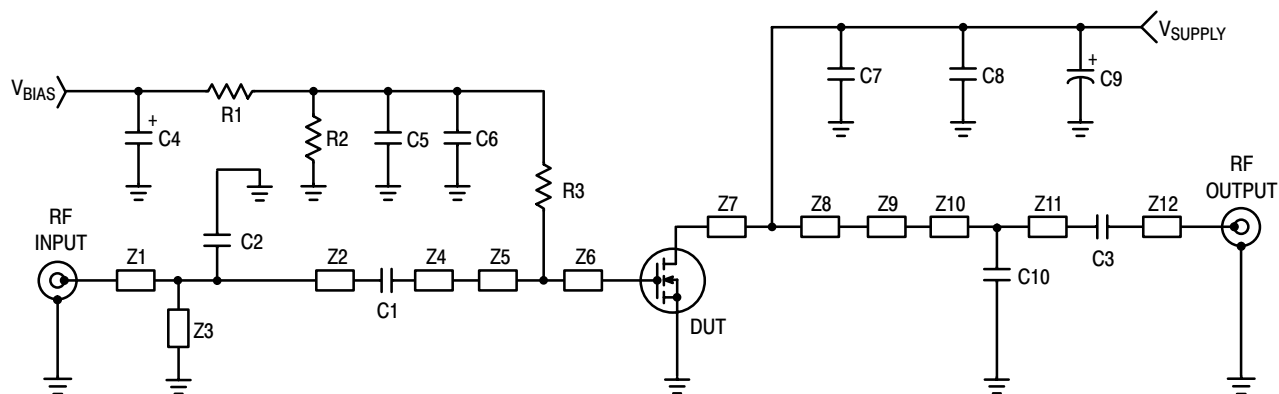
**NOTE - CAUTION** - MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.



**Table 4. Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

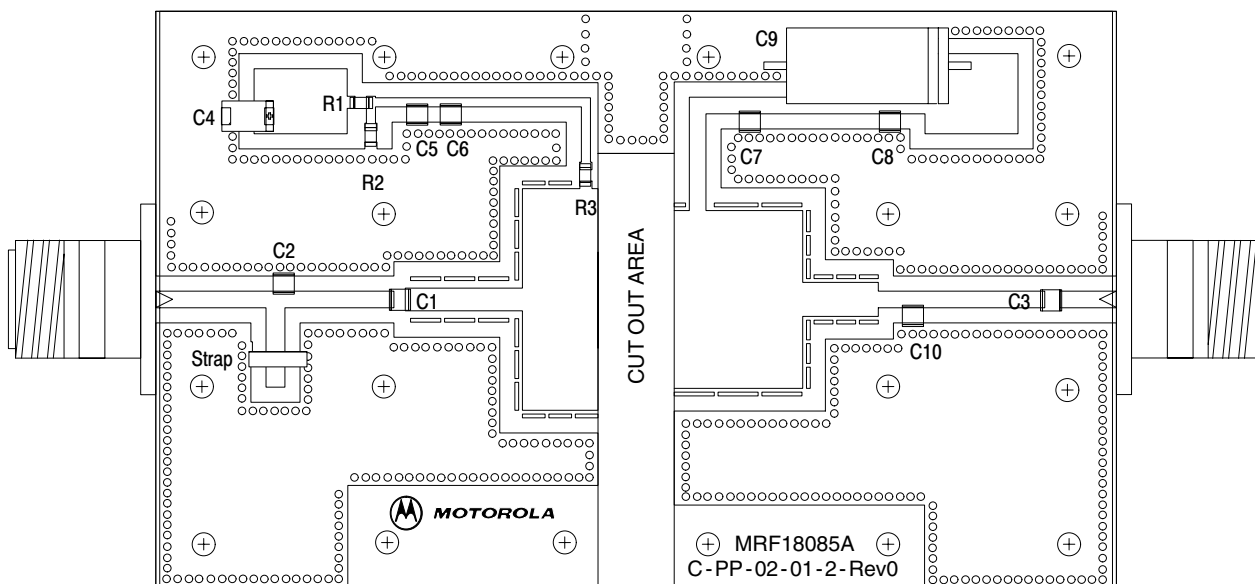
| Characteristic                                                                                                                                                          | Symbol        | Min                                                     | Typ  | Max | Unit            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------------------------------------------|------|-----|-----------------|
| <b>Off Characteristics</b>                                                                                                                                              |               |                                                         |      |     |                 |
| Drain-Source Breakdown Voltage<br>( $V_{GS} = 0\text{ Vdc}$ , $I_D = 100\text{ }\mu\text{Adc}$ )                                                                        | $V_{(BR)DSS}$ | 65                                                      | —    | —   | Vdc             |
| Zero Gate Voltage Drain Current<br>( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )                                                                               | $I_{DSS}$     | —                                                       | —    | 10  | $\mu\text{Adc}$ |
| Gate-Source Leakage Current<br>( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )                                                                                    | $I_{GSS}$     | —                                                       | —    | 1   | $\mu\text{Adc}$ |
| <b>On Characteristics</b>                                                                                                                                               |               |                                                         |      |     |                 |
| Gate Threshold Voltage<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 200\text{ }\mu\text{Adc}$ )                                                                               | $V_{GS(th)}$  | 2                                                       | —    | 4   | Vdc             |
| Gate Quiescent Voltage<br>( $V_{DS} = 26\text{ Vdc}$ , $I_D = 600\text{ mAdc}$ )                                                                                        | $V_{GS(Q)}$   | 2.5                                                     | 3.9  | 4.5 | Vdc             |
| Drain-Source On-Voltage<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )                                                                                          | $V_{DS(on)}$  | —                                                       | 0.15 | —   | Vdc             |
| Forward Transconductance<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )                                                                                         | $g_{fs}$      | —                                                       | 6.0  | —   | S               |
| <b>Dynamic Characteristics</b>                                                                                                                                          |               |                                                         |      |     |                 |
| Reverse Transfer Capacitance <sup>(1)</sup><br>( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1\text{ MHz}$ )                                                         | $C_{rss}$     | —                                                       | 3.6  | —   | pF              |
| <b>Functional Tests</b> (In Freescale Test Fixture, 50 ohm system)                                                                                                      |               |                                                         |      |     |                 |
| Common-Source Amplifier Power Gain @ 85 W <sup>(2)</sup><br>( $V_{DD} = 26\text{ Vdc}$ , $I_{DQ} = 800\text{ mA}$ , $f = 1805 - 1880\text{ MHz}$ )                      | $G_{ps}$      | 13.5                                                    | 15   | —   | dB              |
| Drain Efficiency @ 85 W <sup>(2)</sup><br>( $V_{DD} = 26\text{ Vdc}$ , $I_{DQ} = 800\text{ mA}$ , $f = 1805 - 1880\text{ MHz}$ )                                        | $\eta$        | 48                                                      | 52   | —   | %               |
| Input Return Loss @ 85 W <sup>(2)</sup><br>( $V_{DD} = 26\text{ Vdc}$ , $I_{DQ} = 800\text{ mA}$ , $f = 1805 - 1880\text{ MHz}$ )                                       | IRL           | —                                                       | -12  | -9  | dB              |
| Power Output, 1 dB Compression Point<br>( $V_{DD} = 26\text{ Vdc}$ , $I_{DQ} = 800\text{ mA}$ , $f = 1805 - 1880\text{ MHz}$ )                                          | P1dB          | 83                                                      | 90   | —   | Watts           |
| Output Mismatch Stress @ P1dB<br>( $V_{DD} = 26\text{ Vdc}$ , $I_{DQ} = 800\text{ mA}$ , $f = 1805\text{ MHz}$ ,<br>VSWR = 5:1, All Phase Angles at Frequency of Tests) | $\Psi$        | No Degradation In Output Power<br>Before and After Test |      |     |                 |

1. Part is internally matched both on input and output.
2. To meet application requirements, Freescale test fixtures have been designed to cover the full GSM1800 band, ensuring batch-to-batch consistency.



|                |                                                           |     |                                             |
|----------------|-----------------------------------------------------------|-----|---------------------------------------------|
| C1, C3, C6, C7 | 10 pF Chip Capacitors, ATC                                | Z4  | 0.610" x 0.118" Microstrip                  |
| C2             | 1.8 pF Chip Capacitor, ATC                                | Z5  | 0.331" x 1.153" Microstrip                  |
| C4             | 10 $\mu$ F, 35 V Tantalum Capacitor, AVX                  | Z6  | 0.063" x 1.153" Microstrip                  |
| C5, C8         | 1 nF Chip Capacitors, ATC                                 | Z7  | 0.122" x 0.925" Microstrip                  |
| C9             | 220 $\mu$ F, 63 V Electrolytic Capacitor, Radial, Philips | Z8  | 0.547" x 0.925" Microstrip                  |
| C10            | 0.3 pF Chip Capacitor, ATC                                | Z9  | 0.394" x 0.177" Microstrip                  |
| R1, R2         | 10 k $\Omega$ , 1/4 W Chip Resistors (1206)               | Z10 | 0.180" x 0.087" Microstrip                  |
| R3             | 1.0 k $\Omega$ , 1/4 W Chip Resistor (1206)               | Z11 | 0.686" x 0.087" Microstrip                  |
| Z1             | 0.671" x 0.087" Microstrip                                | Z12 | 0.294" x 0.087" Microstrip                  |
| Z2             | 0.568" x 0.087" Microstrip                                | PCB | Taconnic TLX8, 30 mils, $\epsilon_r = 2.55$ |
| Z3             | 0.500" x 0.098" Microstrip Shorted Stub                   |     |                                             |

**Figure 1. 1800-1880 MHz Test Fixture Schematic**



Freescall has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescall Semiconductor signature/logo. PCBs may have either Motorola or Freescall markings during the transition period. These changes will have no impact on form, fit or function of the current product.

**Figure 2. 1800-1880 MHz Test Fixture Component Layout**

## TYPICAL CHARACTERISTICS

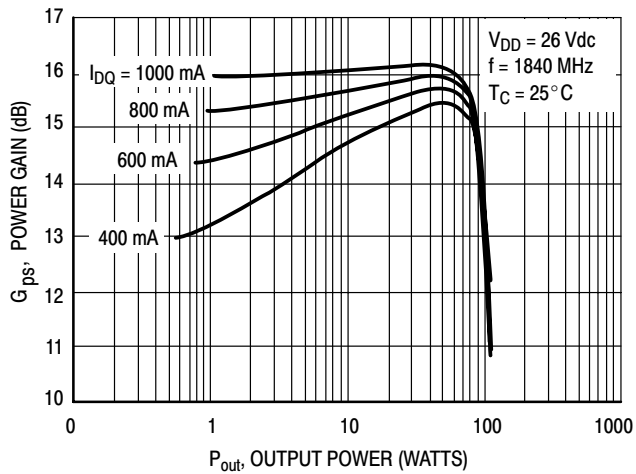


Figure 3. Power Gain versus Output Power

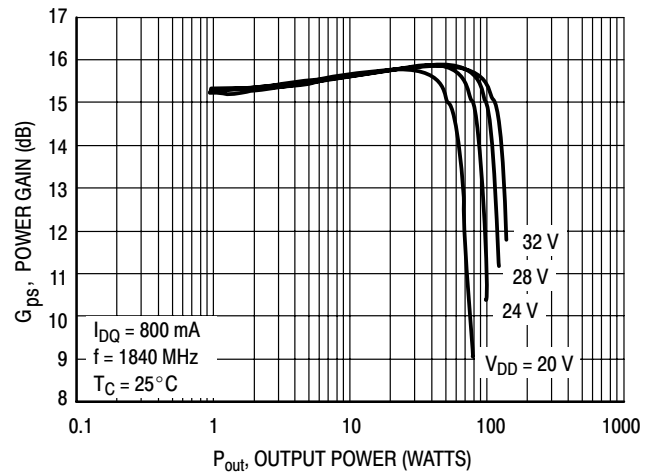


Figure 4. Power Gain versus Output Power

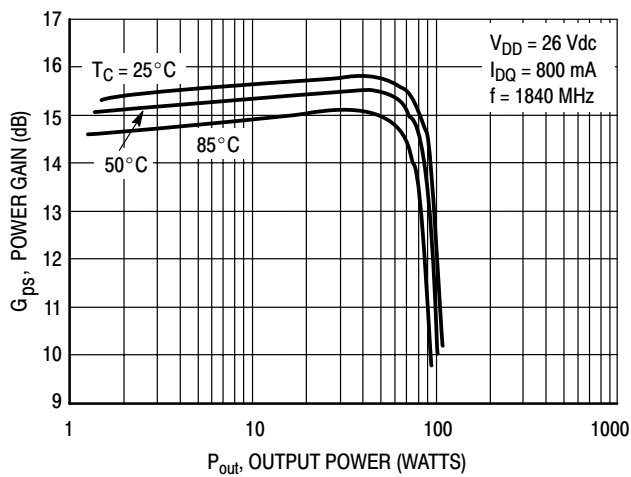


Figure 5. Power Gain versus Output Power

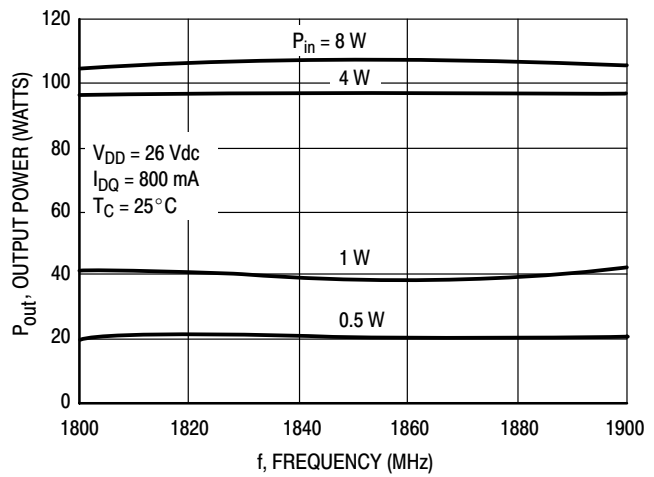


Figure 6. Output Power versus Frequency

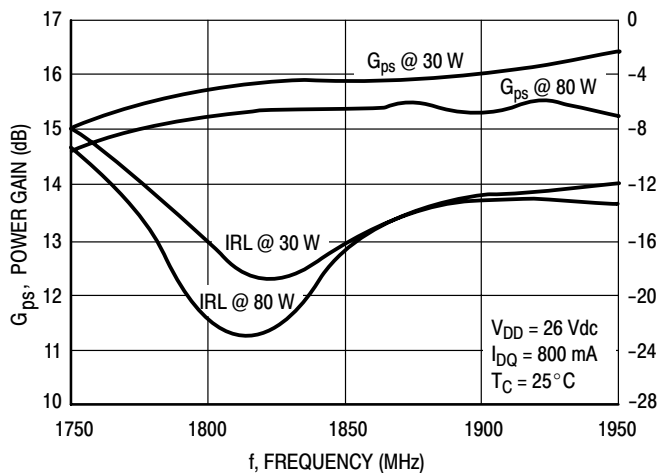


Figure 7. Power Gain versus Frequency

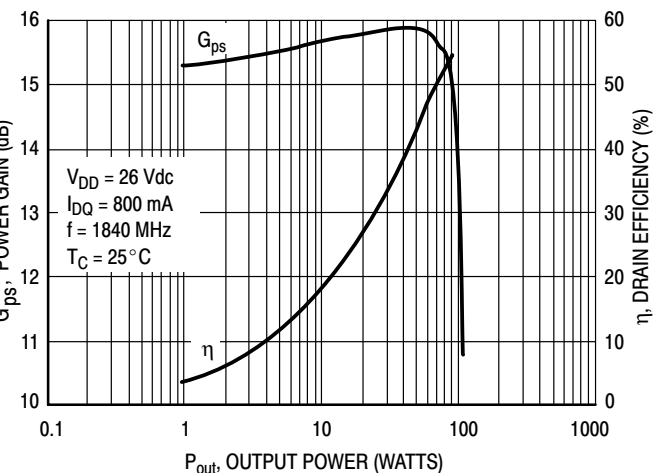
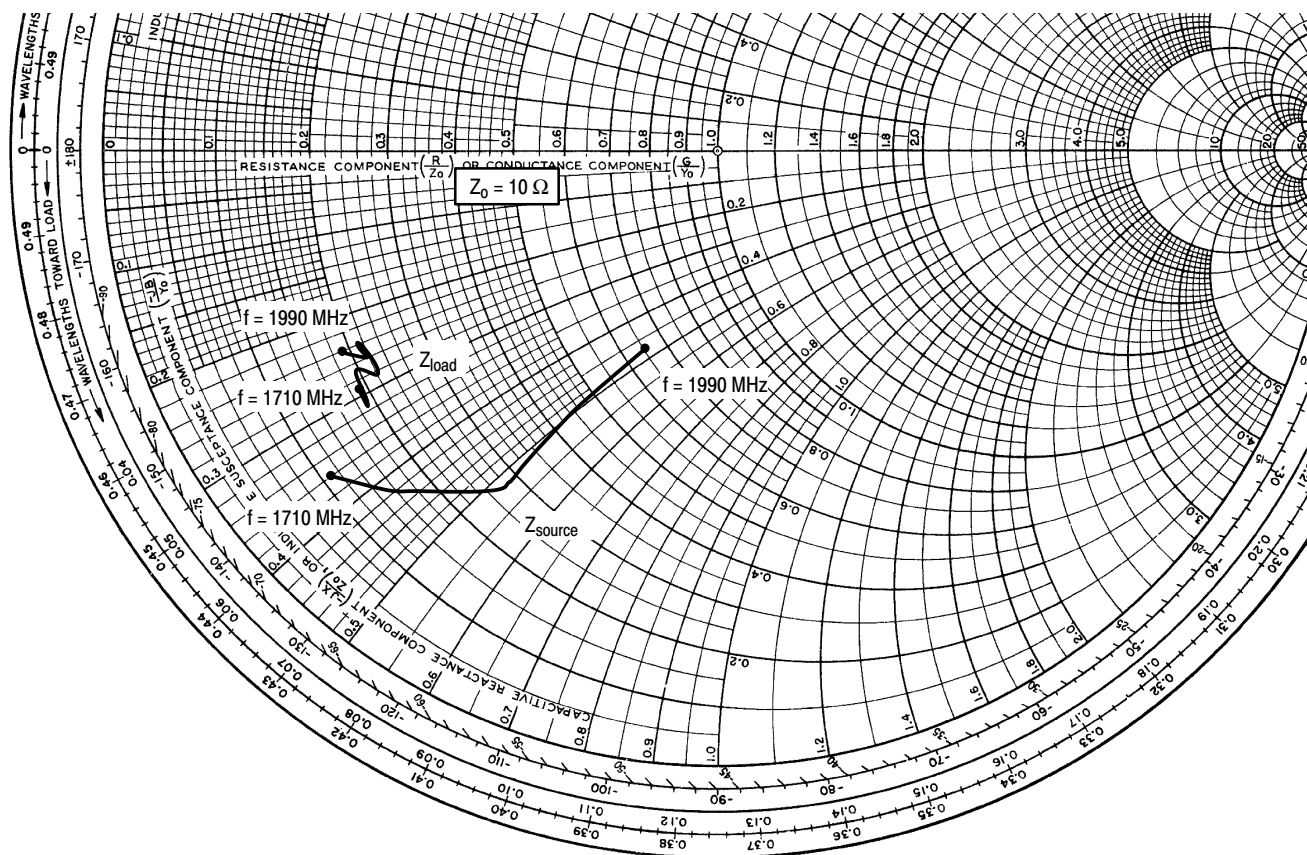


Figure 8. Power Gain and Efficiency versus Output Power



$V_{DD} = 26 \text{ V}$ ,  $I_{DQ} = 800 \text{ mA}$ ,  $P_{out} = 85 \text{ W CW}$

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 1710     | 1.13 - j3.62             | 1.79 - j2.88           |
| 1785     | 1.61 - j4.23             | 1.82 - j3.15           |
| 1805     | 1.69 - j4.34             | 1.90 - j2.66           |
| 1880     | 2.83 - j5.25             | 2.09 - j2.77           |
| 1930     | 3.00 - j5.18             | 2.01 - j2.44           |
| 1960     | 4.39 - j4.97             | 2.01 - j2.57           |
| 1990     | 6.59 - j4.74             | 1.79 - j2.37           |

$Z_{source}$  = Test circuit impedance as measured from gate to ground.

$Z_{load}$  = Test circuit impedance as measured from drain to ground.

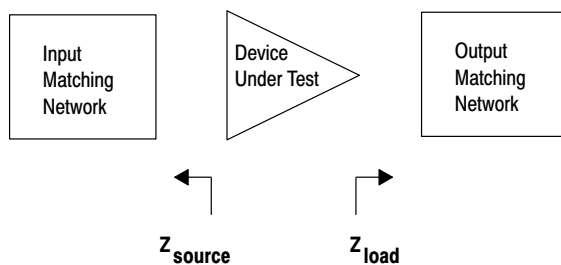
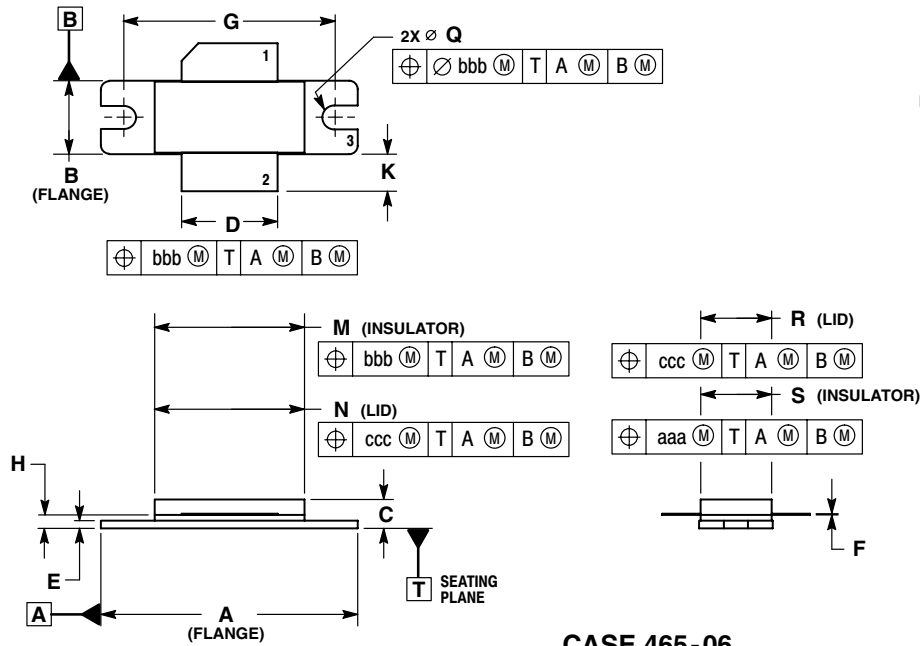


Figure 9. Series Equivalent Source and Load Impedance



## NOTES

## PACKAGE DIMENSIONS



### NOTES:

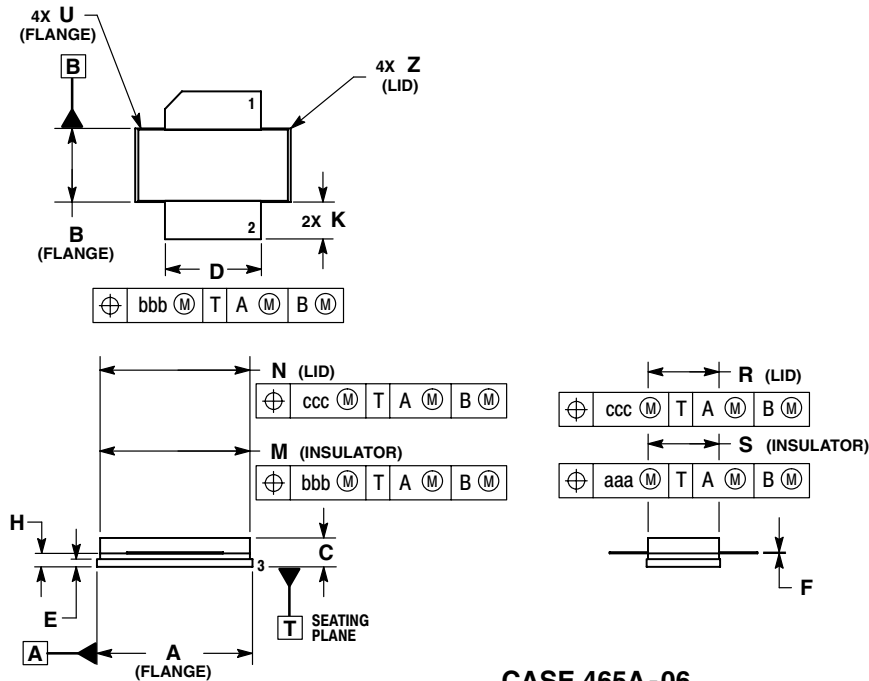
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 1.335     | 1.345 | 33.91       | 34.16 |
| B   | 0.380     | 0.390 | 9.65        | 9.91  |
| C   | 0.125     | 0.170 | 3.18        | 4.32  |
| D   | 0.495     | 0.505 | 12.57       | 12.83 |
| E   | 0.035     | 0.045 | 0.89        | 1.14  |
| F   | 0.003     | 0.006 | 0.08        | 0.15  |
| G   | 1.100 BSC |       | 27.94 BSC   |       |
| H   | 0.057     | 0.067 | 1.45        | 1.70  |
| K   | 0.170     | 0.210 | 4.32        | 5.33  |
| M   | 0.774     | 0.786 | 19.66       | 19.96 |
| N   | 0.772     | 0.788 | 19.60       | 20.00 |
| Q   | Ø.118     | Ø.138 | Ø3.00       | Ø3.51 |
| R   | 0.365     | 0.375 | 9.27        | 9.53  |
| S   | 0.365     | 0.375 | 9.27        | 9.52  |
| aaa | 0.005 REF |       | 0.127 REF   |       |
| bbb | 0.010 REF |       | 0.254 REF   |       |
| ccc | 0.015 REF |       | 0.381 REF   |       |

### STYLE 1:

- PIN 1. DRAIN
- GATE
- SOURCE

**CASE 465-06  
ISSUE F  
NI-780  
MRF18085AR3**



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.805     | 0.815 | 20.45       | 20.70 |
| B   | 0.380     | 0.390 | 9.65        | 9.91  |
| C   | 0.125     | 0.170 | 3.18        | 4.32  |
| D   | 0.495     | 0.505 | 12.57       | 12.83 |
| E   | 0.035     | 0.045 | 0.89        | 1.14  |
| F   | 0.003     | 0.006 | 0.08        | 0.15  |
| H   | 0.057     | 0.067 | 1.45        | 1.70  |
| K   | 0.170     | 0.210 | 4.32        | 5.33  |
| M   | 0.774     | 0.786 | 19.61       | 20.02 |
| N   | 0.772     | 0.788 | 19.61       | 20.02 |
| R   | 0.365     | 0.375 | 9.27        | 9.53  |
| S   | 0.365     | 0.375 | 9.27        | 9.52  |
| U   | ---       | 0.040 | ---         | 1.02  |
| Z   | ---       | 0.030 | ---         | 0.76  |
| aaa | 0.005 REF |       | 0.127 REF   |       |
| bbb | 0.010 REF |       | 0.254 REF   |       |
| ccc | 0.015 REF |       | 0.381 REF   |       |

### STYLE 1:

- PIN 1. DRAIN
- GATE
- SOURCE

**CASE 465A-06  
ISSUE F  
NI-780S  
MRF18085ALSR3**

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